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SPECIFICATION

TITLE OF THE INVENTION

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~~A video camera and a warning method thereof~~

BACKGROUND OF THE INVENTION

The present invention relates to a video camera which displays a warning when a battery becomes near empty, and a warning method thereof.

Conventionally known as a power source of a video camera is, for example, a battery pack including a lithium ion battery, NiCd battery, nickel hydrogen battery, or the like as a secondary battery cell. The battery pack is constructed to be detachable from a battery attachment section provided in the video camera apparatus body.

Normally, in an electric apparatus such as a video camera using this battery pack as a power source, the battery end voltage is determined depending on the terminal voltage of the battery pack. Also, displaying of a warning prior to end of the battery is determined depending on the terminal voltage of the battery pack. The battery end voltage and the voltage for displaying a warning prior to end of battery are generally fixed.

Meanwhile, the discharge characteristic (defined by subtracting a discharge time from a between terminal voltage) of the battery pack differs depending on the type of the battery cell. Even one same cell may have different discharge characteristics,

depending on the cell structure method. Therefore, if the battery end voltage Ve and the warning display voltage Vp prior to end of the battery are both fixed, there is a problem that the time from when a warning is displayed to when the battery actually ends greatly varies depending on the type of the battery pack. For example, suppose three cell structures, e.g., a one-stage cell structure in which two battery cells C1 and C2 are connected in series as shown in FIG. 1(A), a two-stage cell structure in which two stages each consisting of two battery cells C1 and C2 connected in series are connected in parallel as shown in FIG. 1(B), and a three-stage cell structure in which three stages each consisting of two battery cells C1 and C2 are connected in series are connected in parallel as shown in FIG. 1(C). Between these three cell structures, the times T1, T2, and T2 at which warnings prior to end are displayed are greatly different from each other as indicated by the relationships between the battery discharge characteristics F1, F2, and F3 and the warning display times T1, T2, and T3 in FIG. 2.

This problem means lowered reliability with respect to warning display near the battery end of the electric apparatus, and the influence therefrom increases as the consumption power of the apparatus decreases.

The present invention hence has an object of providing a video camera and a warning display method thereof which enable warning display with high reliability.

BRIEF SUMMARY OF THE INVENTION

A video camera according to the present invention comprises: warning display means; and display control means for obtaining a reference voltage value from a voltage correction value which is determined based on information concerning a capacity of a cell in a battery pack, obtained from the battery pack, and an end voltage value at which use of a battery should be ended, and for controlling the warning display means based on a result of comparison between a voltage value of the battery pack and the reference voltage value, wherein the warning display control means controls the warning display means to display a warning when the voltage value of the battery pack becomes equal to or lower than the reference voltage value.

In a warning display method according to the present invention rein a reference voltage value is obtained by subtracting a voltage correction value decided based on information concerning a capacity of a cell in a battery pack, from a prior-to-end warning voltage value at which end of use of the battery is warned, and the reference value thus obtained and a voltage value of the battery pack is compared with each other, and a warning is displayed if the voltage of the battery pack is equal to or lower than the reference voltage value.

As described above, according to the present invention, a voltage correction value decided on the basis of information concerning the capacity of the cell in the battery pack is subtracted from a prior-to-end warning voltage value to obtain a reference voltage value, and the obtained reference voltage value is compared with the voltage value of the battery pack. A warning is displayed when the voltage value of

the battery pack becomes smaller than the reference voltage value. As a result, the time when the warning is displayed can be constant with respect to any of battery packs having various kinds of cell structures, so warning display can be achieved with high reliability.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a view schematically showing the cell structure in a battery pack.

FIG. 2 is a view schematically showing the relationships between the battery discharge characteristics and the warning display times of the battery packs respectively having a one-stage structure, two-stage structure, and three-stage structure in a conventional electronic apparatus.

FIG. 3 is a block diagram showing the structure of a battery power source control system of a camera-integrated video recorder to which the present invention is applied.

FIG. 4 is a flowchart showing a processing procedure of power source control in the camera-integrated video recorder.

FIG. 5 is a flowchart showing specific steps of correction value decision processing in the processing procedure of power source control.

FIG. 6 is a view schematically showing the relationships between the battery discharge characteristics and the warning display times of the battery packs

respectively having a one-stage structure, two-stage structure, and three-stage structure in the camera-integrated video recorder.

DETAILED DESCRIPTION OF THE INVENTION

In the followings, embodiments of the present invention will be explained specifically with reference to the drawings.

The present invention is practiced as a camera-integrated video recorder mounting a battery power source control system having a structure as shown in FIG. 3.

This camera-integrated video recorder is constructed by connecting a video camera recorder body 10 with a battery pack 20 through a power source line 40 and a communication line 30.

The video camera recorder body 10 is provided with a positive terminal 12 and a negative terminal 13 connected with the power source line 40, and a communication terminal 11 connected with the communication line 30. Also, the video camera recorder body 10 is provided with a microcomputer 14 having a function to transmit and receive data to and from the outside through the communication terminal 11, a display section 15 controlled by the microcomputer 14, a power control section 16, and the like.

The video camera recorder body 10 is supplied with a power from the battery pack 20 through the positive and negative terminal 12 and 13, and the microcomputer

14 receives internal information concerning the battery pack 20 through the communication terminal 11. Also, the microcomputer 14 includes internally a voltage detector section 17 and detects the voltage of the power source supplied through the positive and negative terminals 12 and 13 as will be described later. Based on the detection result therefrom, the microcomputer 14 controls the display section and the power control section 16.

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Also, the battery pack 20 is provided with positive and negative terminals 23 for inputting a power, which are connected with the power source line 40, and a communication terminal 23 connected with the communication line 30. This battery pack 20 comprises a microcomputer 24 which functions to transmit and receive data to and from the outside through the communication terminal 11, and a cell structure section 25 internally including a battery cell which supplies the video camera recorder body 10 with a power through the positive and negative terminals 22 and 23, and the like. The cell structure section 25 internally includes a plurality of battery cells which are constructed in a two-stage or three-stage structure. The status of the battery cells in the cell structure section 25 is monitored by the microcomputer 24.

Further, in this camera-integrated video recorder, power source control is carried out in accordance with a procedure as shown in FIG. 4.

Specifically, the microcomputer 14 of the video camera recorder body 10 detects the voltage of the power source supplied through the positive and negative terminals 12 and 13, i.e., the battery voltage Vb of the battery pack 20, by the voltage

detector section 17 (step S1), thereby to determine whether communication with the microcomputer 24 in the battery pack 20 side is possible or not (step S2).

If the determination in the step S2 is "NO" which means that communication is not possible, e.g., in case where the microcomputer 24 of the battery pack 20 does not work normally or the battery pack 20 is not connected, the microcomputer 14 in the video camera recorder body 10 then ends the processing.

Otherwise, if the determination in the step S2 is "YES", i.e., if communication with the microcomputer 24 in the battery pack 20 side is possible, the microcomputer 14 in the video camera recorder body 10 obtains a standard capacity as one of property information items (such as a voltage, current, and a residual battery amount) inherent to the battery pack 20 (step S3) and further carries out a residual amount calculation (step S4).

Next, the microcomputer 14 of the video camera recorder body 10 determines the type of the battery pack 20 (e.g., the cell structure of the cell structure section 25 in this example) based on the standard capacity obtained as a property information item inherent to the battery pack 20, and decides a prior warning display voltage correction value ΔVp prior to end of the battery, corresponding to the type (step S5).

The correction value decision processing in the step S5 will now be explained specifically with reference to FIG. 5.

That is, in this correction value decision processing, the microcomputer 14 in the video camera recorder body 10 determines whether or not the standard capacity obtained by communication is larger than the battery capacity of the battery pack having a cell structure section constructed in the two-stage structure (step S21).

Further, if the determination result in the step S21 is "YES" which means that the standard capacity obtained by communication is larger than the battery capacity of the battery pack whose a cell structure section has a two-stage structure, the microcomputer 14 in the video camera recorder body 10 sets the prior warning display voltage correction value ΔVp to a correction value $\Delta Vp3$ corresponding to the battery capacity of the battery pack whose cell structure section has a three-stage structure (step S22).

Otherwise, if the determination result in the step S21 is "NO" which means that the standard capacity obtained by communication is smaller than the battery capacity of the battery pack of the battery pack whose cell structure section has a two-stage structure, the microcomputer 14 in the video camera recorder body 10 further determines whether or not the standard capacity obtained by communication is larger than the battery capacity of the battery pack whose cell structure section has a one-stage structure (step S23).

Further, if the determination result in the step S23 is "YES" which means that the standard capacity obtained by communication is larger than the battery capacity of the battery pack whose cell structure section has a one-stage structure, the

microcomputer 14 in the video camera recorder body 10 sets the prior warning display voltage correction value ΔVp to a correction value $\Delta Vp2$ corresponding to the battery capacity of the battery pack whose cell structure section has a two-stage structure (step S24).

Further, if the determination result in the step S21 is "NO" which means that the standard capacity obtained by communication is smaller than the battery capacity of the battery pack whose cell structure section has a two-stage structure, the microcomputer 14 in the video camera recorder body 10 sets the prior warning display voltage correction value ΔVp to a correction value $\Delta Vp1 = 0$ (step S25).

At this time, the warning display voltage correction value ΔVpn corresponding to the cell structure of the battery pack (where n = 1, 2, 3) is previously stored together with a standard prior warning voltage value Vp in the memory of the microcomputer 14 of the video camera recorder body 10.

After the prior warning display voltage correction value ΔVp is thus decided, the microcomputer 14 of the video camera recorder body 10 subtracts the prior warning display voltage correction value ΔVp from the standard prior warning voltage value Vp thereby to obtain a corrected prior warning display voltage value Vpn in correspondence with the type of the battery pack 20 (step S6).

$$Vpn = Vp - \Delta Vpn \text{ (where n = 1, 2, 3)}$$

Then, whether or not the battery voltage value Vb of the battery pack 20 detected by the voltage detector section 17 in the step S1 is larger than the corrected prior warning

voltage value Vpn is determined (step S6).

Also, if the determination result in the step S7 is "YES" which means that the battery voltage Vb of the battery pack 20 is higher than the corrected prior warning display voltage value Vp, the microcomputer 14 of the video camera recorder body 10 controls the display section 15 to display the residual amount calculated by the step S4, so residual amount display is thus carried out (step S8). Thereafter, the microcomputer returns to the step S1 and performs repeatedly the above-described processing.

Otherwise, if the determination result in the step S7 is "NO" which means that the battery voltage Vb of the battery pack 20 is lower than the corrected prior warning display voltage value Vp, the microcomputer 14 of the video camera recorder body 10 determines whether or not the battery voltage value Vb of the battery pack 20 is higher than the end voltage value Ve (step S9)

If the determination result in the step S9 is "YES" which means that the battery voltage value Vb of the battery pack 20 is higher than the end voltage Ve, the microcomputer 14 of the video camera recorder body 10 controls the display section 15 to perform display of a warning prior (step S10), and then returns to the step S1 and performs repeatedly the processing described above.

Further, if the determination result in the step S9 is "NO" which means that the battery voltage value Vb of the battery pack 20 is smaller than the end voltage value

Ve, the microcomputer 14 of the video camera recorder body 10 ends the processing for power source control.

At this time, the battery end voltage value Ve is stored in the memory of the microcomputer 14 in the video camera recorder body 10 or the memory of the microcomputer 24 in the battery pack 20.

In this kind of camera-integrated video recorder, the microcomputer 14 of the video camera recorder body 10 obtains a corrected prior warning display voltage Vpn which is corrected with a voltage correction value ΔVpn decided in accordance with the type of the battery pack 20, based on information concerning the capacity of the cell in the battery pack which is obtained from the battery pack 20. Display of a warning is started when the battery voltage value Vb of the battery pack 20 becomes equal to or lower than the prior warning display voltage value Vpn. The display of the warning is further ended when the battery voltage value Vb reaches the end voltage value Ve at which use of battery should be ended. Therefore, the prior warning display time prior to end of battery can be constant with respect to any battery pack having any cell structure, as schematically indicated by the relationships between the battery discharge characteristics F1, F2, and F3 and the warning display times T1, T2, and T3.